COS 426 : Precept 11
Particle Systems

Agenda

- What you need to do
- Framework introduction
  - Updaters
  - Initializers
  - System Settings

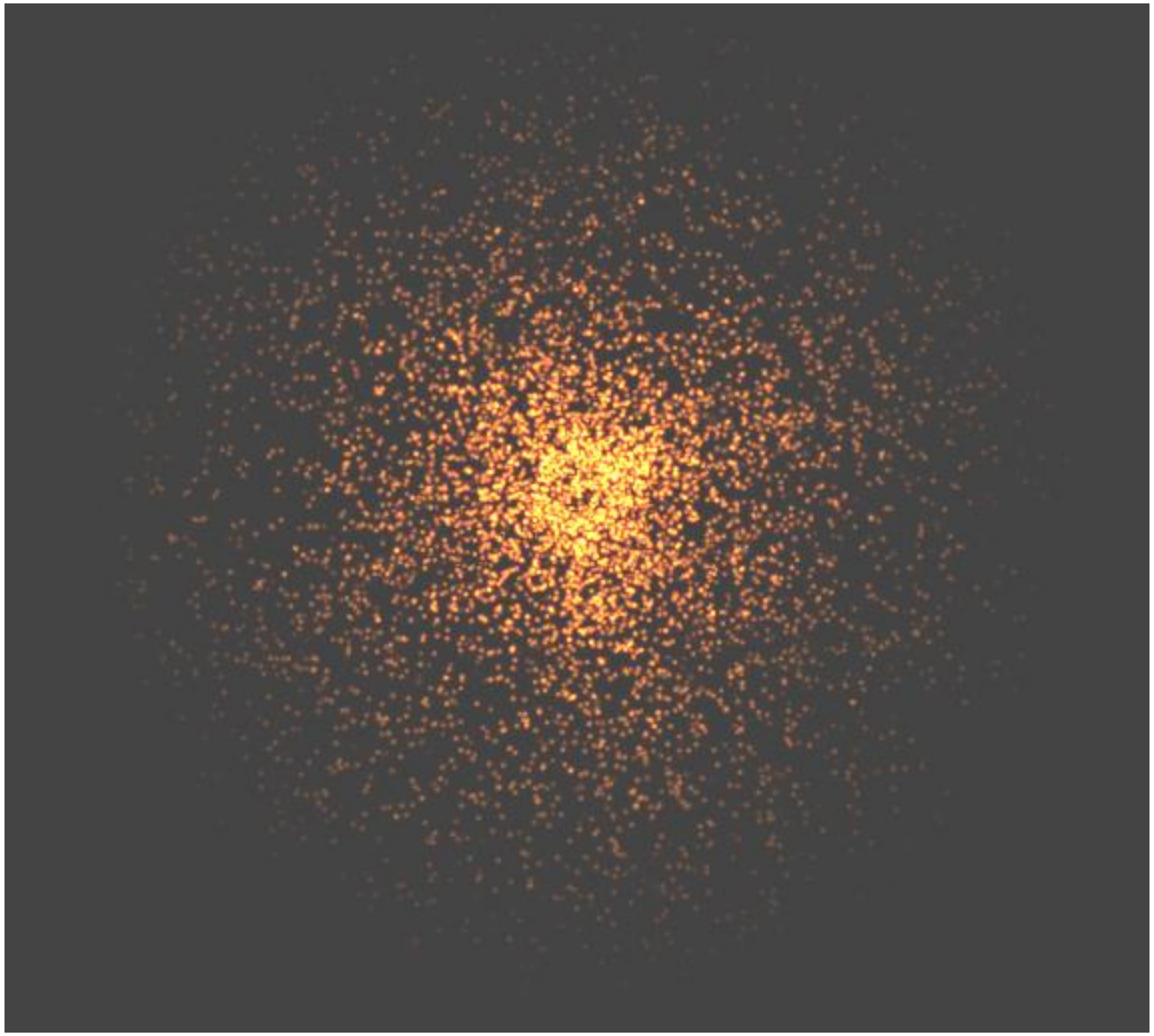
Assignment details

- Easier, worth bit less points
- More freedom / burden on you
- Required features
  - Euler Integration
  - Sphere Initialization
  - Mesh Initialization
  - Simple collisions
  - Sinks
  - Cloth
  - Damping

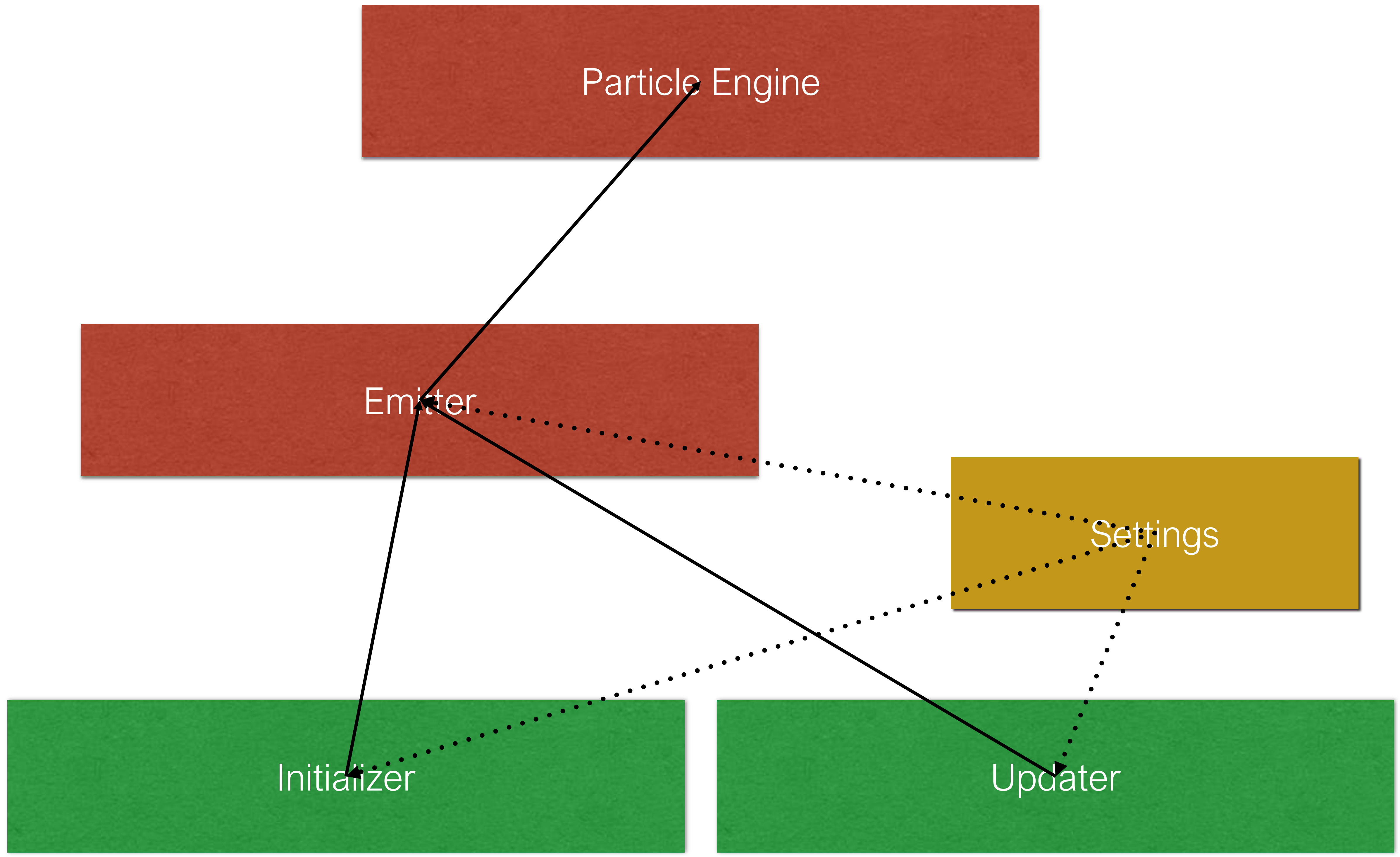
Wait, slow down…

- Particle systems
  - Each particle has number of attributes
    - Positions
    - Velocities
    - Colors
    - Sizes
    - Lifetimes
    - Etc…
  - Initialize certain number of particles at each time-step
  - Update each particle at each time-step
- Different Initialization / update -> Different effects

Yay!



Framework



Initializer

- Function that specifies how new particles are generated
  - What is the position
  - What is initial velocity
  - Etc.
- Takes in a set of options
  - Can be anything that you need
  - Stored in this._opts variable
- Must implement initialize function!
  - Framework calls MyInitializer.initialize();

Initializer

- Example
  - new MyInitializer({position: new THREE.Vector3() });
  - Position can be accessed as
    - this._opts.position
  - initialize (particleAttributes, toSpawn)
    - particleAttributes - arrays of positions, velocities, etc.
    - toSpawn - array of indices into these arrays
  - Particle Engine manages when to remove the particles
    - Just use toSpawn array!

Arrays side note

- Fixed size buffer
  - Buffer stores max. 1000 particles
  - Generate 100 particles per second
  - Each particle lives 11 seconds
- Need to be able to know when particle is dead to free up space in array
  - Lifetime < 0 ——> kill particle (utils.js)
- This is managed for you!

Updater

- Function that specifies how new particles are updated
  - Apply forces to particles
  - Do collision detection
  - Change velocities/colors etc.
- Wide range of possible effects!
- Takes in set of options
  - Can be anything that you need
  - Stored in this._opts variable
- Must implement update function!
  - Framework calls MyUpdater.update();

Updater

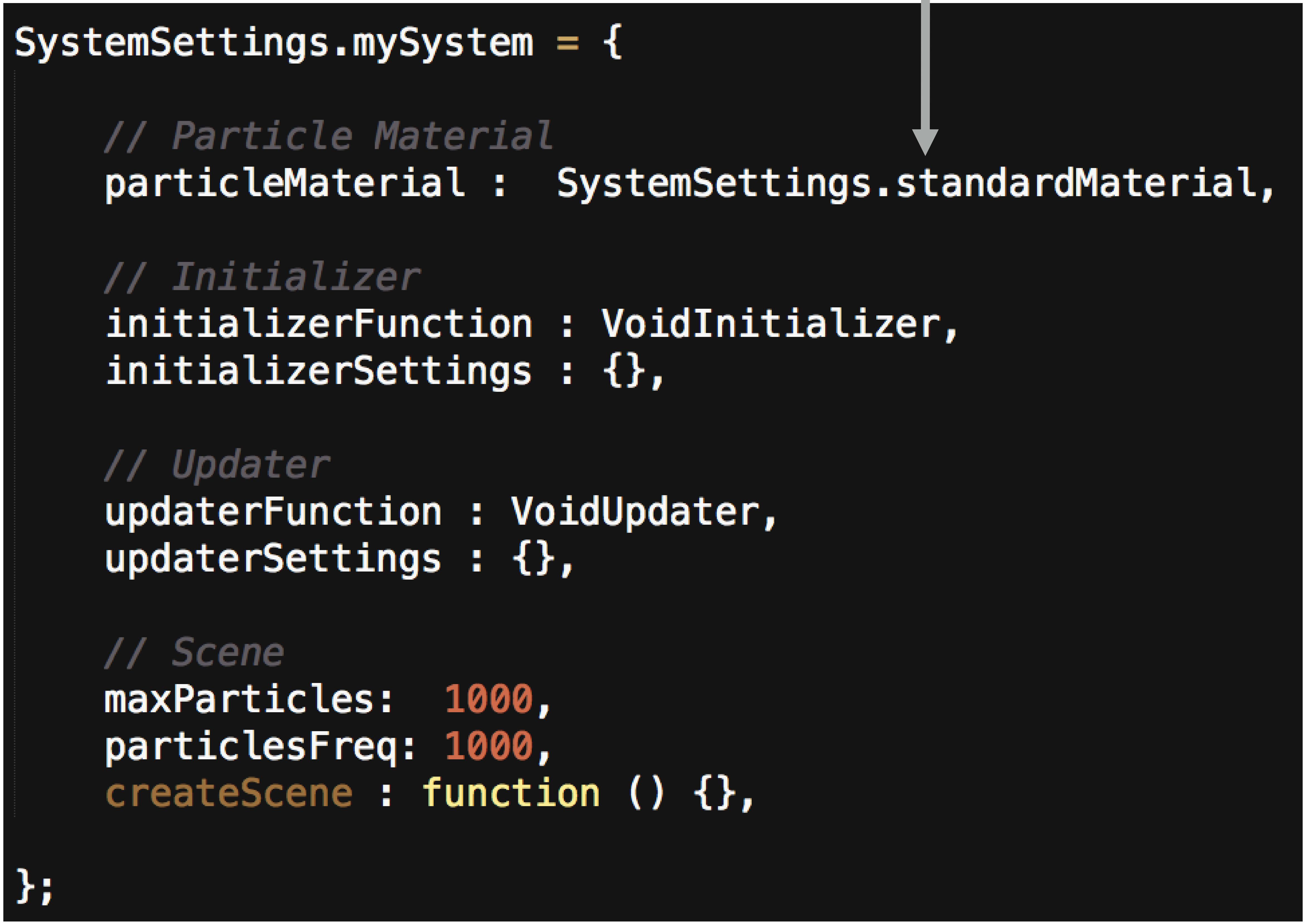
- new MyUpdater({gravity: new THREE.Vector3(0, -10, 0) });
- Can be accessed as
  - this._opts.gravity
- Similarly you can pass other useful things:
  - Collidable objects
  - Sinks
- update (particleAttributes, alive, delta_t)
  - particleAttributes - arrays of positions, velocities, etc.
  - initialized - array of specifying whether particle is initialized (active)
    - Only update active particles
  - delta_t - global time, used for your integration

Settings

- Particle Engine can be specified with set of settings
  - systemSettings.js
- Need to specify
  - Updater + Updater options
  - Initializer + Initializer options
  - Material
  - Max Particle Count (Buffer Size)
  - Particle Frequency

Settings

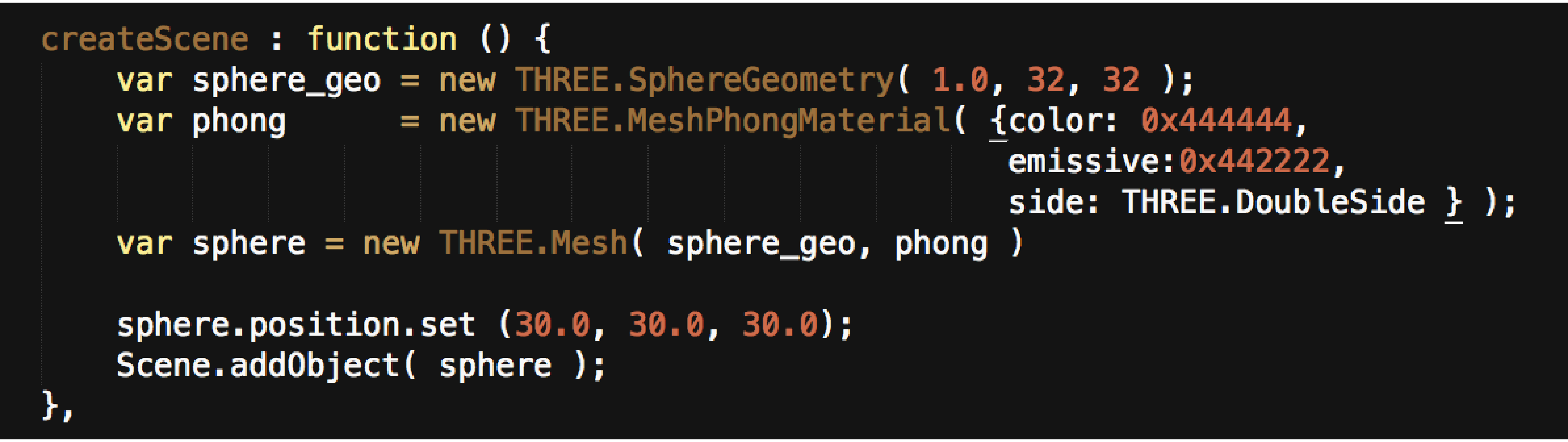
Sufficient for all required features



```
SystemSettings.mySystem = {

    // Particle Material
    particleMaterial :  SystemSettings.standardMaterial,

    // Initializer
    initializerFunction : VoidInitializer,
    initializerSettings : {},

    // Updater
    updaterFunction : VoidUpdater,
    updaterSettings : {},

    // Scene
    maxParticles:  1000,
    particlesFreq: 1000,
    createScene : function () {},

};
```

Settings - Optional

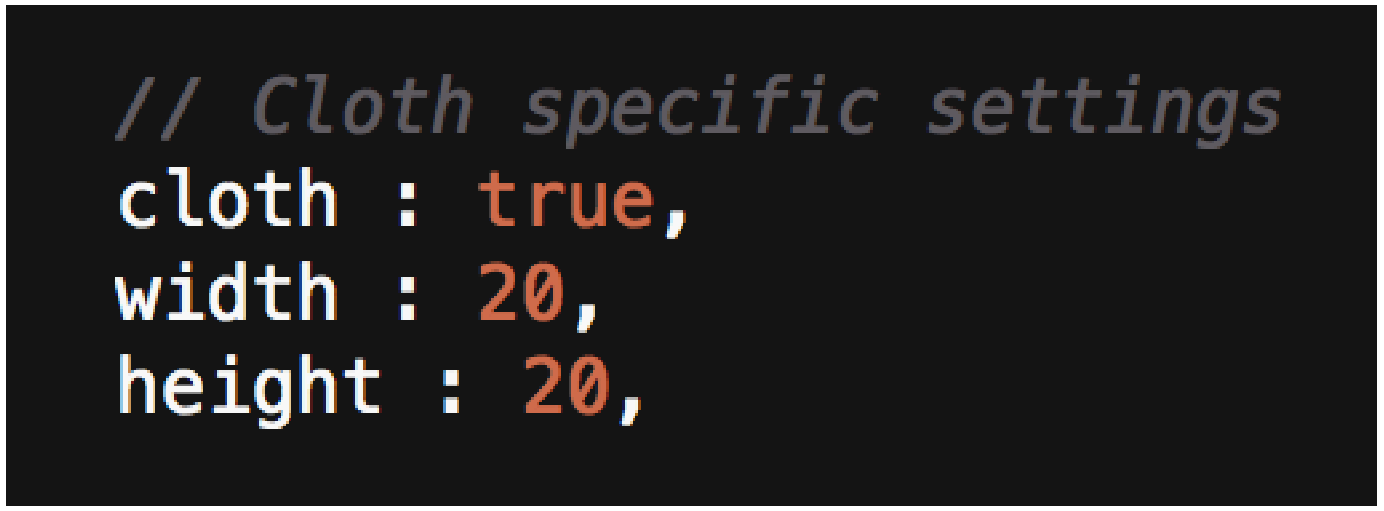
- Scene
  - Just write a function that creates THREE.js objects
  - Add them to the scene



```
createScene : function () {
    var sphere_geo = new THREE.SphereGeometry( 1.0, 32, 32 );
    var phong      = new THREE.MeshPhongMaterial( {color: 0x444444,
                                                    emissive:0x442222,
                                                    side: THREE.DoubleSide } );
    var sphere = new THREE.Mesh( sphere_geo, phong )

    sphere.position.set (30.0, 30.0, 30.0);
    Scene.addObject( sphere );
},
```

Settings - Optional

- Cloth
  - Rendered differently
  - Need to define grid structure



```
// Cloth specific settings
cloth : true,
width : 20,
height : 20,
```

  - max. particle count and particle frequency ignored.

Utils.js

- particleAttributes arrays access
  - Huge array of numbers
    - particleAttributes.position[0] returns number, not THREE.Vector3 !
  - Provided functions
    - getElement(i, attribute)
    - setElement(i, attribute, val)
    - getGridElement(i, j, width, attribute)
    - setGridElement(i, j, width, attribute, val)
- Also have function to kill particles
  - Useful for sinks!